

M.D. PHYSIOLOGY

COURSE CONTENT

The students would be working in the department for 3 years. So proper time plan can be done on the course content. Teaching sessions will be held in the form of seminars, journal clubs, microteaching, tutorials and discussions.

1) Theory:

- To attend the U.G. lectures
- To attend P.G. lectures at other P.G. Centres.
- To conduct microteaching sessions
- To teach theory topics for U.G. Students.

2) Practicals:

- To attend the practicals and demonstrations taught by senior teachers for U.G Students and later all practicals to U.G. Students.
- To perform amphibian and mammalian experiments, inclusive of basic techniques of handling of laboratory animals, anaesthesia, dissection and instruments.

3) To learn evaluation techniques

- To learn in detail the teaching learning methods and the methods of evaluation in practicals and theory
- Should be able to take a class using audiovisual aids right from blackboard and chalk to that with laptop and multimedia session

4) Research:

- To attend Journal club / seminars.
- Visits to library to get acquainted with scientific journals
- To carry out thesis work & to learn basic topics in statistics.
- To attend meeting organised by clinical departments.
- To attend local and national conferences

5) Exposure to Medical Education Technology Workshops.

- Should learn to use all audiovisual aids

6) Posting

The postgraduate student will rotate through allied clinical departments such as Biochemistry, Pathology, Transfusion Medicine, General Medicine, Pulmonary Medicine, Cardiology, Neurology, Endocrinology and Nephrology.

7) Thesis

Every candidate shall carry out work on an assigned research project under the guidance of a recognized Postgraduate teacher; the project shall be written and submitted in the form of a thesis. Every candidate shall submit thesis plan to the university with in the time frame set by university. The student will identify a relevant question; (ii) conduct a critical review of literature; (iii) formulate a hypothesis; (iv) determine the most suitable study design; (v) state the objectives of the study; (vi) prepare a study protocol; (vii) undertake a study according to the protocol; (viii) analyse and interpret research data, and draw conclusions; (ix) write a research paper.

8) Log book

Every candidate shall maintain a log book.

9) Assessment

Each PG student is to be assessed daily for their academic activities and also periodically. The assessment shall be –

- Valid, objective and reliable
- cover cognitive, psychomotor and affective domains
- formative, continuing and summative conducted in theory as well as practicals/clinicals.

Syllabus

Theory

General Physiology

Introduction to Physiology
Principles of Homeostasis
Structure of cell membrane, Intercellular communications
Mechanisms of Transport across cell membrane
Body Fluid compartments
Blood volume
Apoptosis and aging

Hematology

Blood - Functions, composition, Properties
Plasma proteins
Red Blood Cells
Morphology, composition, functions, normal RBC count and variations, properties
Haemoglobin – structure, normal content, functions, types, abnormal Hb
Erythropoiesis – sites (intra and extrauterine) different stages,
Factors influencing and regulating Erythropoiesis
Life Span of RBC and its destruction, jaundice
Anaemias – definition, classifications (etiological, morphological), physiological basis of anaemias, investigations

Bone marrow study – Importance, myeloid: erythroid ratio

White Blood Cells:

Classification, morphology, lifespan

Properties and functions

Normal total and differential count, variations

Leucopoiesis

Immunity

Definition, Types – innate and acquired, Humoral and cellular

Mechanisms of immune response, plasma cell, immunoglobins,

Autoimmune disorders, AIDS

Platelets:

Morphology, properties and functions, normal count, variations, thrombopoiesis, and factors influencing this Reticuloendothelial system

Haemostasis

Primary (vasospasm, platelet plug formation) and

Secondary (extrinsic and intrinsic mechanisms of coagulation of blood)

Clot retraction

Anticlotting mechanisms in vivo

Anticoagulants - used in lab and in vivo

Bleeding disorders

Tests for bleeding disorders

Thrombosis and Embolism

Blood groups

ABO and Rh systems, inheritance, differences, Bombay group,

Landsteiner's laws I and II

Other minor blood groups, bombay blood group

Blood grouping and cross matching, concept of universal donor and recipient

ABO and Rh incompatibility

Management and preventive measures, Medicolegal and clinical importance

Blood banking and transfusion

Blood transfusion – indications, precautions and complications

Blood Banking –anticoagulants used, storage, changes during storage

Transfusion of blood components – with special reference to recent advances

Lymph – formation, circulation, functions

Tissue fluid – formation, circulation and functions

Starling's hypothesis – edema formation

Cardiovascular system

Functional anatomy of heart and blood vessels

Properties of cardiac muscle

Conducting system of heart

Parts of conducting system, origin and spread of cardiac impulse,

Abnormal pacemakers, conduction defects

Cardiac cycle:

Definition, phases, events of cardiac cycle

Volume and Pressure changes – in different chambers and major vessels

Heart sounds – causes, character, murmur (definition, physiological basis)

Arterial Pulse - genesis, characters of normal pulse, common abnormalities

Venous blood flow- Venous tone, valves, factors affecting

Correlation between different events of cardiac cycle

Non invasive investigations in cardiology

ECG

Definition, Principles of recording of ECG

Leads

Normal tracings in all leads

In Lead II – normal waves, intervals and segments, how HR is determined, correlation with action potential and phases of cardiac cycle

Clinical uses of ECG

Abnormal ECG pattern in myocardial infarction, cardiac arrhythmias

Effect of changes in ECF K^+ , Ca^{++} and Na^+

Conduction defects

Cardiac output:

Definition, normal values, variations

Method of measurement

Regulation of cardiac output

Correlation of normal ECG pattern with events of cardiac cycle in a diagram

Haemodynamics

Functional organisation correlated with structure of vascular system

General principles including physical laws governing flow of blood in heart and blood vessels

Pressure – resistance - flow relationship

Laminar flow, turbulent flow, Reynold's number, critical closing volume

Importance of peripheral resistance, venous circulation, venous tone

Regulation of blood flow – local and general

Arterial Blood pressure

Systolic and diastolic pressures– definition, normal values, variations

Define end pressure and lateral pressure, Bernoulli's principle

Pulse pressure, Mean arterial pressure

Determinants of Systolic and diastolic pressures - Measurement

Regulation - neural and humoral (short term, intermediate and long term)

Cardiovascular reflexes

Local regulation including auto regulation of blood flow, vasoconstrictors and vasodilators, substances secreted by endothelium

Effects of gravity, Posture and Exercise on B.P

Hypertension & hypotension

Regional circulations

Circulatory shock

Types, pathophysiology, stages, compensatory mechanisms

Cardio-vascular adjustments in health and disease

Respiratory System

Introduction

Organisation and functional anatomy of respiratory system

Functions of different parts of respiratory system including non-respiratory functions

Mechanics of respiration

Surfactant

Law of laplace – application

Measurement of pulmonary ventilation

Lung volumes and capacities

Ventilation – pulmonary and alveolar

Dead space – Anatomical & Physiological

Pressure – volume relationship

Elastic behaviour of lungs, total and lung compliance

Airway resistance, work of breathing, factors affecting bronchial tone,

Pulmonary blood flow

Volume, pressure, factors influencing, unique features.

Ventilation – perfusion ratio and its importance

Pulmonary gas exchange

Composition of inspired air, alveolar and expired air, partial pressures gas composition of arterial and venous blood

Mechanism of gas exchange

Structure of blood gas barrier, factors affecting diffusion across respiratory

Membrane diffusion capacity

O₂ transport in blood

O₂ dissociation curves

CO₂ transport in blood

CO₂ dissociation curve

Regulation of respiration

Neural control

Chemical control

Interactions between these chemical stimuli

Hypoxia

Definition, types, clinical features, differences

Oxygen therapy

Cyanosis, asphyxia and dyspnoea

Definition, CO poisoning

Periodic breathing

Cheyne – stokes and biots breathing, voluntary hyperventilation

Environmental Physiology

High altitude, rapid ascent, mountain sickness, acclimatization

Effects of UV rays, dysbarism

Effects of increased barometric pressure

Nitrogen narcosis, High pressure nervous syndrome, Oxygen toxicity

Decompression sickness (Caissons disease)

Pulmonary function tests

Artificial respiration

Mouth to mouth, Holger-Neilson method, mechanical methods, ventilators

Gastrointestinal System

Introduction to G.I. Physiology

General organization of G.I. tract

Neural control of G.I function, enteric nervous system

Mechanism of enzyme secretion by glands in general

Salivary glands

Functional anatomy (types and location) with relevant histology

Saliva

Composition, functions, control of secretion

Conditioned and unconditioned reflexes
Disturbances in salivary secretion
Gastric secretion
Functional anatomy of stomach and different gastric glands
Gastric juice: Composition, functions, phases of secretion and regulation
Gastric HCl secretion - mechanism and regulation of secretion
Gastrin – functions and regulation of secretion
Mucosal barrier, pathophysiology of peptic ulcer
Pancreatic secretion -- exocrine Pancreas
Functional anatomy with relevant histology
Pancreatic juice: Composition, function, and regulation of secretion
Applied importance
Liver and gall bladder
Functions of Liver, Functional anatomy with relevant histology
Composition and functions of bile, control of secretion
Functions of gall bladder
Enterohepatic circulation, Jaundice
Small intestine
Functional anatomy with relevant histology
Composition, regulation of secretion, and functions of intestinal juice
Small intestine – Functions
Movements of G.I. tract
Electrophysiology of smooth muscle in the GIT
Peristalsis
Mastication
Deglutition
Gastric motility – types, regulation, abnormal movements (vomiting, diarrhoea)
Gastric emptying – duration, factors affecting
Movements of small intestine
Large intestine
Functions – secretory, motor, absorptive, synthesis of short chain fatty acids
Defecation reflex
Role of dietary fibre, bacterial flora
Renal Physiology
Introduction
Functions of kidney – homeostasis, as an endocrine organ
Functional anatomy of Kidney
Renal circulation
Juxtaglomerular apparatus
Glomerular filtration
Clearance values
Tubular functions
Tubular reabsorption
Water, Sodium, glucose, water, urea, electrolytes - sites, mechanisms involved
Tubular secretion
Filtered load, Tubular maximum, glomerulo tubular feed back, and renal threshold
Acidification of urine
Concentration of urine
Counter current system – multiplier, exchanger
Cortico medullary gradient, Osmotic gradient along renal tubules

Diuresis

Micturition

Functional anatomy of bladder and innervation of bladder,

Filling and emptying of bladder, Cystometrogram

Micturition reflex and its higher control, voluntary control

Abnormalities of micturition

Urine

Normal volume, constituents

Abnormal constituents – albuminuria, glucosuria

Polyuria, Oliguria, Anuria

Dialysis – artificial kidney

Renal function tests

Skin and Temperature regulation

Structure and function of skin

Methods of heat conservation and loss in human body

Regulation of body temperature

Hyperthermia, Fever, Heat stroke, hypothermia, cold injuries (frost bite)

Nerve – Muscle Physiology

Excitable tissue

Definition, properties

Neuron

Structure of a typical neuron, types, properties, functions

Stimulus

Definition, types – threshold, subthreshold, suprathreshold

Nerve fibres

Types, classification, and functions

Resting membrane potential

Nerve action potential

Transmission of nerve impulses

Peripheral nerve injury

Neuromuscular junction

Functional anatomy, transmission of impulses across neuromuscular junction

Neuromuscular blocking drugs

Applied clinical aspects

Muscles

Classification

Skeletal muscle

Structure including molecular details

Action potential

Molecular basis of muscle contraction

Types of muscle contraction

Muscle types – fast and slow

Energy sources and metabolism in muscle at rest and during contraction

Muscular changes during exercise

Length –tension relationship

EMG

Fasciculation, fibrillation

Cardiac muscle

Structure, properties

Action potential

Pacemaker potential
Mechanism of contraction
Length – tension relation ship
Smooth muscle
Types, Structure, innervation and neuromuscular junction
Potentials
Mechanism of contraction - Excitation – contraction coupling
Plasticity
Length – tension relation ship
Nervous system
Organisation of nervous system
General organisation
Functional anatomy of brain and spinal cord
Brain – lobes, functions, Brodmann's areas
Neuron, neuroglia – functions
Spinal cord – Functional anatomy -
Cross section with location of sensory, motor and autonomic neurons and tracts
Cerebro spinal fluid
Ventricles of brain, Blood-brain barrier- importance
CSF – formation, circulation, composition, functions, Lumbar puncture
Synapse
Types
Functional anatomy of typical chemical synapse and synaptic transmission
Synaptic potentials
Properties of synapses
Synaptic inhibition
Neurotransmitters and neuromodulators
Reflex action
Definition, reflex arc - components
Classification with examples
Sensory receptors
Classification (recent view), types (phasic and tonic), properties - adaptation
Receptor potential, comparison with action potential
Sensations
Classification
Sensory tracts
Organisation of sensory pathways
Tracing of pathways from body and face
Pain Sensation – details
Different types of pain
Modulation of pain - Spinal level, supra spinal level
Visceral pain, referred pain, radiating pain, - clinical correlates
Altered pain sensations
Thalamus
Functional anatomy, nuclei – classification, connections, Functions of thalamus
Thalamic syndrome
Sensory Cortex
Location – primary area, secondary area, association areas
Salient histological features, Sensory homonculus
Lesions

Motor system

Introduction, levels of motor control

Reflex action

Definition, Reflex arc

Classification of reflexes with examples

Stretch reflex, inverse stretch reflex, reciprocal innervation, withdrawal reflex

Motor Cortex

Motor areas

Motor homonculus

Descending tracts

General organisation, Pyramidal and extra pyramidal tracts, their functions

Upper motor neurons and lower motor neurons, their lesions

Effects of lesions at various levels - hemiplegia, paraplegia, monoplegia

Spinal cord injuries

Injuries of spinal cord: complete transection, incomplete transection, hemisection, section of anterior and posterior roots, injury to motor nerve

Basal ganglia

Organisation, Connections, Functions

Disorders

Cerebellum

Functional anatomy, Functional and evolutionary divisions, functions

Deep cerebellar nuclei, connections in relation to functions, functions

Neuronal circuit

Cerebellar lesion

Reticular formation

ARAS, descending reticular system –explain control of muscle tone

Functions

Limbic system

Organisation, connections and functions

EEG and sleep

Define EEG, principle of recording,

Normal waves , Clinical uses (

Vestibular apparatus

Functional anatomy

Connections and Vestibular pathway, Functions

Muscle tone, posture, equilibrium

Basis of maintenance – stretch reflex, higher control,

Postural reflexes – mention with levels of integration (details not required)

Regulation of muscle tone and posture

Hypothalamus

Functional anatomy, Nuclei, connections and functions

Higher functions of the brain

Learning

Memory

Speech

Autonomic nervous system

Organisation and functions

Special Senses

Olfaction

Receptor, pathway, lesions

Taste

Taste buds, receptor, primary taste sensations, pathway, lesions

Vision

Functional anatomy of eye

Chambers of the eye, intraocular fluids,

Lens - characteristics, changes with age, aphakia, cataract

Retina – Histology, Macula lutea, fovea centralis

Basic optics

Optical system of the eye

Refractive media of eye

Concepts of reduced eye, Image formation on retina

Emmetropic eye, Far and near points

Accommodation and accommodation reflex (Near response) –

Errors of refraction, Presbyopia

Contact lenses

Visual receptors (cones and rods)

Structure in detail

Visual pigments, role of vitamin A

Phototransduction

Adaptations of visual receptors - Dark adaptation and light adaptation

Electrophysiology of receptors, receptor potential, lateral inhibition

Electroretinogram

Duplicity theory of vision, photopic and scotopic vision

Muscles of eye

Names, nerve supply and movements of eyeball

Corresponding points, double vision and squint

Colour vision

Primary, secondary and complementary colours

Hue, brightness and saturation

Receptors

Trichromatic and Opponent Process Theories

Colour blobs – location and function

Colour blindness

Afterimages, contrasts

Visual pathway

Mono ocular and binocular vision

Visual signals - Processing in the Retina

Pathway -Important features to be specified at all levels

Effects of lesion at different levels

Macular sparing (recent views)

Visual cortex – all areas and functions

Visual reflexes

Papillary light reflex (direct and indirect) - pathway, lesion)

Accommodation reflex – pathways, lesions

Corneal reflex - pathway

Tests of Vision -Field of vision, Visual acuity, Color vision

Audition

Acoustics – frequency, amplitude of sound, pitch, intensity, and quality of sound

Functional anatomy of the ear

Functions of external, middle and inner ear

Cochlea

Structure, Organ of corti,

Hair cell physiology, Mechano-electrical transduction by hair cells

Endocochlear potential

Descrimination of pitch (travelling wave theory) and intensity of sound

Auditory pathway

Sound localisation, pitch discrimination, masking of sounds

Deafness

Audiometry

Endocrinology

General endocrinology

Names and organisation of Endocrine glands in human body

Hormone – definition, and classification

Mechanism of action of hormones.

Control of secretion of hormones in general – the + ve and –ve feed back

Abnormalities of hormone function

Hormonal assay

Hypothalamus

Functional anatomy, Hormones, their physiological actions

Interrelationship between hypothalamus and pituitary glands –

Infundibulum -hypothalmo –pituitary tract and portal system

Pituitary gland

Functional anatomy, cell types

Hormones of anterior and posterior pituitary

Growth hormone - physiological actions and regulation of secretion, Hyper and hypofunction

Other hormones to be dealt with the target glands,

Mention intermediate lobe hormones - - pro opiomelanocortin and MSH

Thyroid gland

Hormones- biosynthesis, transport, physiological actions (physiologic, pharmacologic and pathologic) and regulation of secretion (H-P-T axis)

Thyroid function tests

Hyper and hypofunction in children and adults

Pancreas – endocrine

Functional anatomy, Hormones- physiological actions and regulation of secretion

Hyper and hypofunction

Insulin - receptors and insulin resistance

Glucagon, Somatostatin, Pancreatic polypeptide

Adrenal gland

Adrenal Cortex

Functional anatomy

Hormones of adrenal cortex - glucocorticoids, mineralocorticoids, sex steroids

Biosynthesis, transport, physiological actions and regulation of secretion

Hyper and hypofunction

Adrenal medulla

Hormones (catecholamines) , regulation of secretion, clinical aspects

Calcium homeostasis

Normal calcium metabolism

PTH, calcitonin and vitamin D - target organs and physiological actions

Hypocalcemia and tetany

Other endocrine glands

Kidney, Pineal body, Thymus, White adipose tissue, Heart, endothelium

Local hormones

Sources and physiological actions

Physiology of growth and development

Correlation of actions of different hormones from infancy, childhood, puberty and adulthood

Physiology of Reproduction

Introduction

Sex organs, genetic basis of sex

Sex differentiation and development of Reproductive system

Factors influencing development of genitalia

Aberrant sexual differentiation

Chromosomal developmental

Puberty – normal, precocious and delayed puberty

Male reproductive system

Functional anatomy

Functions of testis – endocrine, Spermatogenesis

Abnormalities of testicular function

Erection, ejaculation, composition of semen, sterility

Female reproductive system

Functional anatomy

Ovary - oogenesis, ovulation, corpus luteum,

Ovarian hormones, Control of ovarian functions by H- P- Gonadal axis

Pituitary gonadotropins (FSH, LH)

Menstrual cycle

Phases, Ovarian, uterine and vaginal changes during menstrual cycle

Hormonal regulation

Abnormalities of ovarian function

Menarche, menopause, Castration before and after puberty

Pregnancy

Fertilisation, implantation, Corpus luteum of pregnancy

Placenta – functions, Placental hormones

Foetoplacental unit

Pregnancy tests

Parturition – physiology of labour

Lactation

Hormones influencing and their actions

Contraception

Temporary and permanent methods in males and females, and their physiological basis

DETAILS OF PRACTICALS

Human Physiology

1. Use and care of microscope and microscopic examination of blood
2. PCV, ESR, osmotic fragility
3. Haemoglobin estimation and blood indices

4. RBC count
5. WBC count
6. Examination of peripheral blood smear
7. Differential WBC count – normal, abnormal, anaemias
8. Platelet count
9. Reticulocyte count
10. Absolute eosinophil count
11. ABO grouping, Rh typing
12. Bleeding time, clotting time
13. Recording of BP – effects of posture and exercise
14. Recording of arterial pulse
15. Respiratory movements
16. General examination
17. Examination of Respiratory system
18. Examination of CVS
19. Examination of higher functions and sensory system
20. Examination of Motor system
21. Examination reflexes
22. Examination of cranial nerves

Experimental physiology

1. Appliances in experimental physiology Laboratory including physiograph
2. Pithing, muscle nerve preparation, mounting, effects of different types of stimuli
3. Simple muscle twitch
4. Two successive stimuli, repetitive stimuli and fatigue
5. Genesis of tetanus and Starling's law of muscle
6. Effect of load and after load on muscle contraction
7. Effects of variations of temperature on muscle contraction
8. Velocity of nerve impulse
9. Normal cardiogram of frog's heart and effects of heat and cold.
10. Effect of temperature on frog's heart
11. Refractory period of frog's heart
12. Stannius ligatures. Properties of cardiac muscle – all or none law, treppe, summation of subminimal stimuli (demonstration)
13. Effect of vagal stimulation on frog's heart
14. Perfusion of frog's heart – action of ions, action of drugs

(Demonstration through e-modules/recorded graphs)

Mammalian experiments

1. Heart perfusion
2. Intestinal movements Biopotentials on
 - Oscilloscope
 - Electro encephalogram (EEG)
 - Electromyogram (EMG)
 - Electro Cardio Gram (ECG)

- Audiometry
- Perimetry
- Spirometry

Suggested Books

Core Books:

- Text book of Medical Physiology by Guyton & Hall
- Review of Medical Physiology by William F. Ganong
- Understanding of Medical Physiology by Bijlani

Reference Books:

- Physiological basis of medical practice by Best & Taylor
- Wintrob's clinical hematology
- Clinical neuroanatomy for medical students (Richard S Snell)
- Harrison's Principles of Internal Medicine
- Williams Text book of Endocrinology
- Bern & Levy Physiology
- Text book of Medical Physiology by Indu Khurana

Journals:

- Annual Review of Physiology
- Indian Journal of Physiology & Pharmacology
- Journal of Applied Physiology
- Physiological reviews
